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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/712,740	11/13/2003	In Kyu Chun	20059/PIA30957	8888

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EXAMINER	
MALSAWMA, LALRINFAMKIM HMAR	

ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 02/09/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/712,740	CHUN, IN KYU	
	Examiner	Art Unit	
	Lex Malsawma	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 November 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-6* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *13 November 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Modak** (6,537,913 B2) in view of **Liu** (6,211,085 B1).

Regarding claim 1:

Modak discloses a method of forming a Cu line in semiconductor fabrication, comprising:

forming a dual damascene pattern (Fig. 1a) by etching a PMD 101 layer formed on a substrate 100, wherein the dual damascene pattern includes a contact hole portion 103 located on the substrate and a trench portion 104 located on the contact hole portion, the width of the contact hole portion being narrower than that of the trench portion;

depositing a "first" diffusion barrier 106 (Fig. 1b and Col. 3, lines 4-6) on sidewalls of the dual damascene pattern;

filling the dual damascene pattern with "a first metal" 105 (copper) by depositing the first metal on the first diffusion barrier to form a first metal layer;

chemical mechanical polishing a portion of the first metal layer 105 over the trench portion (Col. 3, lines 23-26);

etching the upper part of the first metal layer in the trench portion to form a first-metal plug 111 (Fig. 1c and Col. 4, lines 10-14) that occupies a lower part of the first metal layer in the trench portion and the contact hole portion (Fig. 1c);

depositing a second diffusion barrier 107 on the first-metal plug 111 Fig. 1d; and

depositing a second metal 108 on the second metal diffusion barrier 107 (Fig. 1d).

Modak **lacks** the "first metal layer 105" being tungsten and the "second metal layer 108" being copper. However, it is important to note that Modak discloses the essential process steps/sequence of the current claim; and the only essential difference between the Modak and the current invention seems to be in preferred materials for the first and second metal layers. ***Furthermore, it is important to note that Modak specifically discloses (in Col. 5, lines 22-29), "[a]lthough the foregoing description has specified certain...materials..., those skilled in the art will appreciate that many modifications and substitutions may be made".*** Liu is **cited primarily to show** it was very well known in the art that a dual-damascene-contact structure may be formed by specifically incorporating tungsten and copper, wherein tungsten is used to fill a contact hole portion (i.e., used as a first metal layer) and copper is used to fill the trench portion of the dual-damascene-contact structure (i.e., the copper is used as a second metal layer).

In sum, Modak discloses the essential process steps of the claimed invention and specifies that many substitutions may be made at least for the materials specified in the disclosure. Liu shows that the specific materials (W and Cu) recited in the claimed invention are well known to be suited for a dual-damascene-contact structure. Accordingly, it would have been obvious to one of ordinary skill in the art to modify Modak by specifically utilizing materials such as W and Cu because Liu shows that such materials are well-known to be

suited for a dual-damascene-contact structure, and it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter obvious design choice. *In re Leshin*, 125 USPQ 416.

3. Claims 2-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Modak** (in view of **Liu**) as applied to claim 1 above, and further in view of Huang et al. (5,527,736; hereinafter, "**Huang**").

Regarding claim 2:

Modak (in view of Liu) **lacks** performing dry-etching process on the first metal layer 105; however, it is noted that Modak specifies a wet-etching process is used primarily because the first metal layer is specifically copper (Col. 4, lines 10-14). Huang **teaches** that it is conventional in the art to utilize dry etching when forming a recessed tungsten plug 24 within a contact hole (note Figs. 2, 5, Col. 1, lines 31-33; and Col. 2, lines 57-60). Given that Modak (in view of Liu) incorporates a tungsten layer to provide a tungsten plug, it would have been obvious to one of ordinary skill in the art to specify a dry-etching process performed on the tungsten layer (of Modak in view of Liu) because Huang teaches that it was conventional in the art to etch tungsten by dry etching.

Regarding claims 3 and 4:

Modak discloses the first diffusion barrier 106 includes titanium nitride and the second diffusion barrier layer 107 includes tantalum nitride (Col. 3, lines 4-6 and Col. 4, lines 25-28).

Regarding claims 5 and 6:

The cited references disclose the claimed invention except for specific ranges for height and diameter for the dual damascene contact structure. It would have been obvious to one of ordinary skill in the art to specify ranges as currently claimed because a specific range would depend on a particular design (or design requirement), and it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233.

Remarks

4. Applicant's remarks/arguments have been fully considered but they are not persuasive. The applicant asserts that it would not have been obvious to combine the cited references because Modak teaches that copper should not be used since it may oxidize (see Applicant's remarks, page 4, last paragraph). In the text cited by the applicant (i.e., Col. 1, lines 15-20), Modak discloses, "[w]hen copper is used to make such an interconnect pad, the copper may oxidize if exposed"; and Modak further describes a way in which one could specifically prevent oxidation when incorporating copper. The examiner disagrees with the applicant's assertion because Modak merely discloses that copper may oxidize if exposed, and contrary to the applicant's assertion, Modak specifically utilizes copper along with one means for preventing oxidation, i.e., Modak does not in anyway teach away from using copper especially because Modak specifically uses copper. In reference to the applicant's further submission that the present invention relates to a method for forming a contact to connect a metal line to a silicon substrate, Modak discloses (in Col. 2, lines 1-14) that substrate 100 may be any surface, e.g., a

surface comprising a silicon wafer. Therefore, applicant's remarks/arguments are not persuasive and all pending claims stand rejected 35 USC § 103.

Conclusion

5. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lex Malsawma whose telephone number is 571-272-1903.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Lex Malsawma

February 2, 2005

Supervisory Patent Examiner
Technology Center 2800